

March 3, 1959

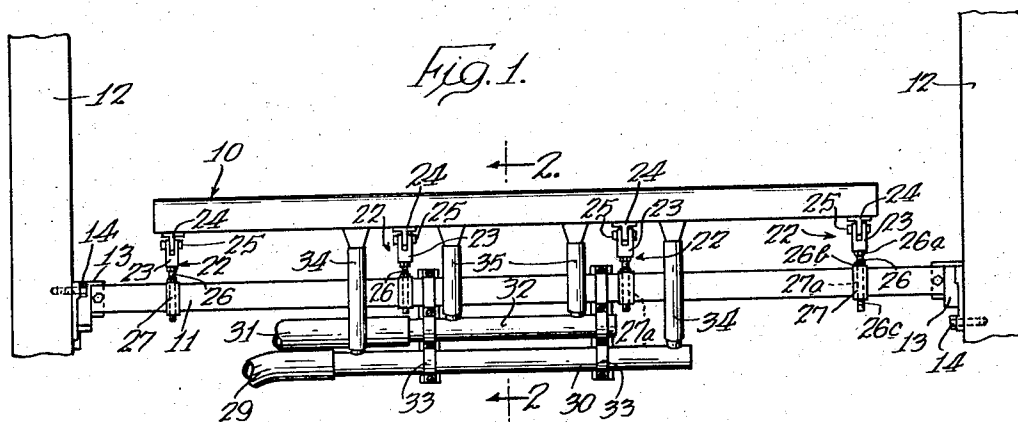
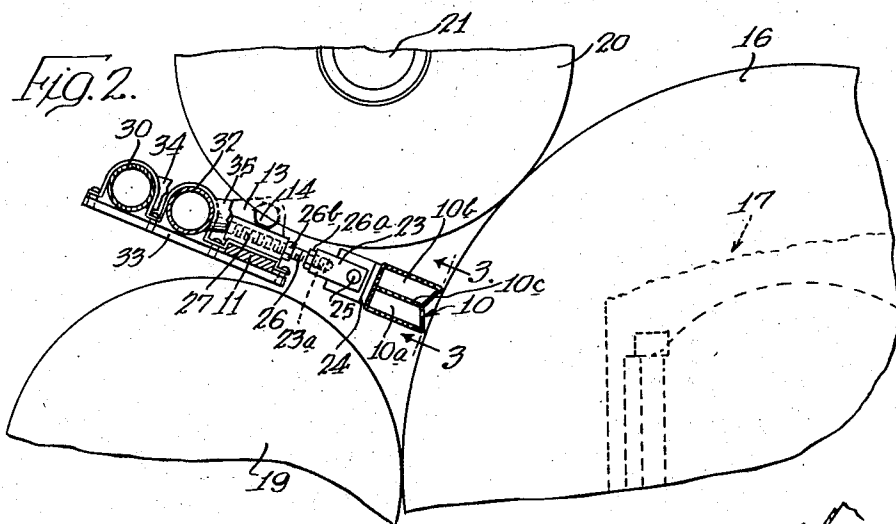
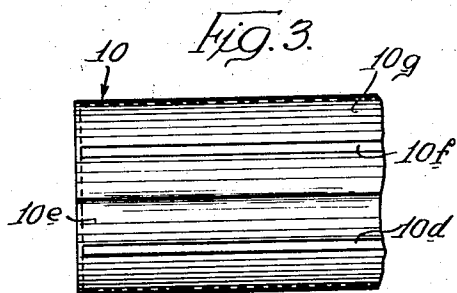
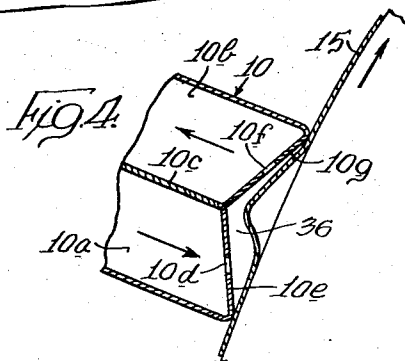
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2,875,846

DIFFERENTIAL PRESSURE CLEANING APPARATUS

Filed April 4, 1955

3 Sheets-Sheet 1



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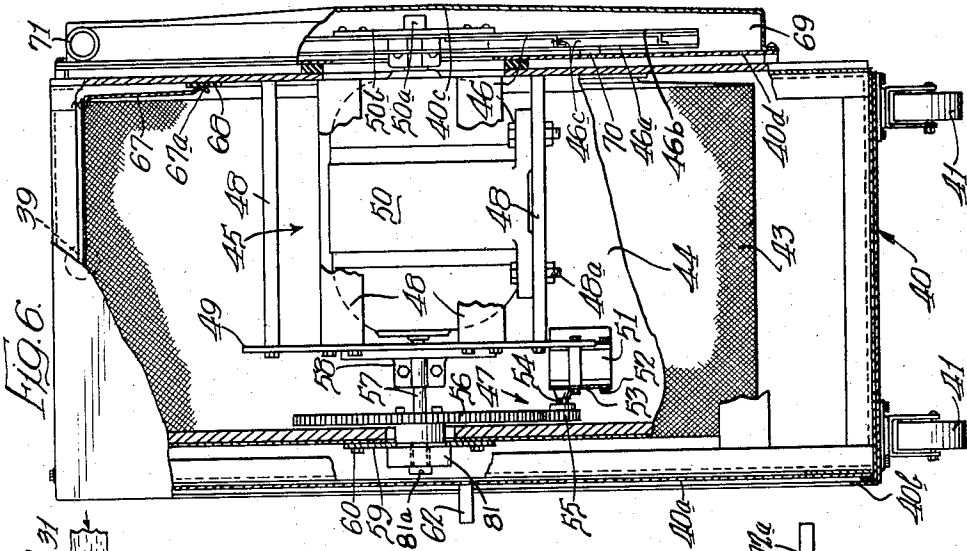
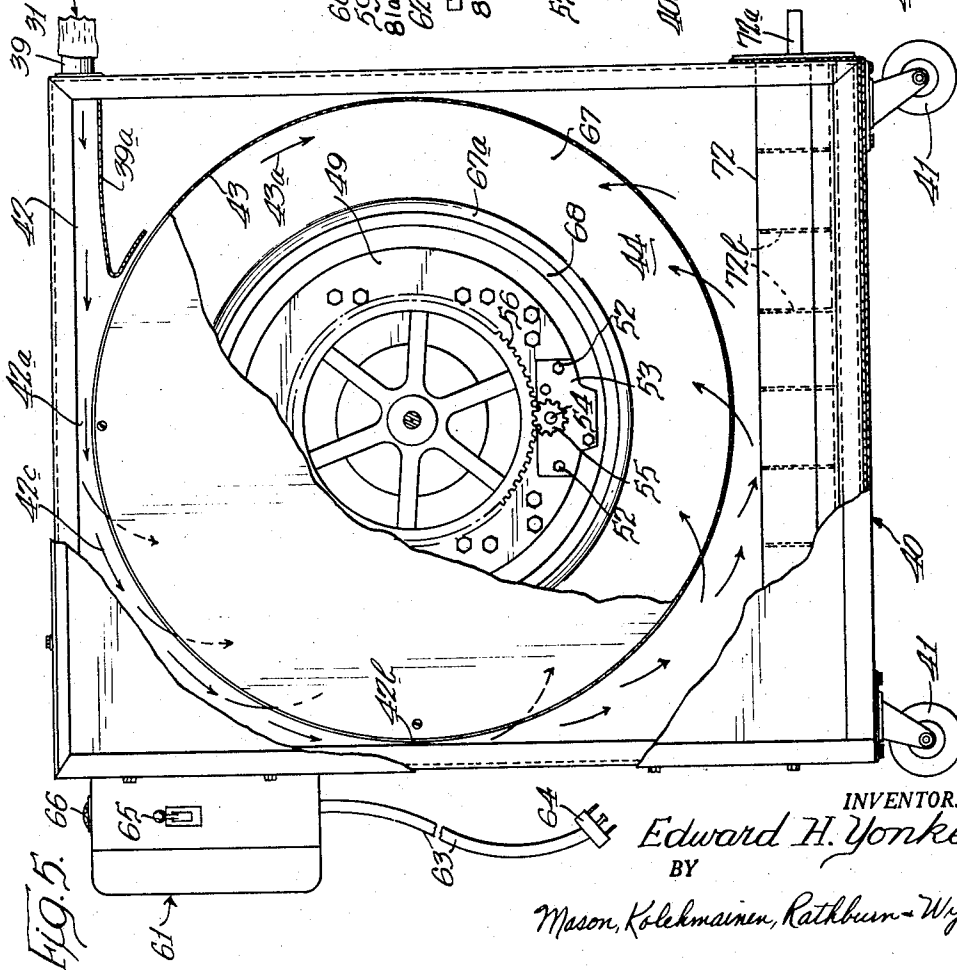
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DIFFERENTIAL PRESSURE CLEANING APPARATUS

Filed April 4, 1955

3 Sheets-Sheet 2



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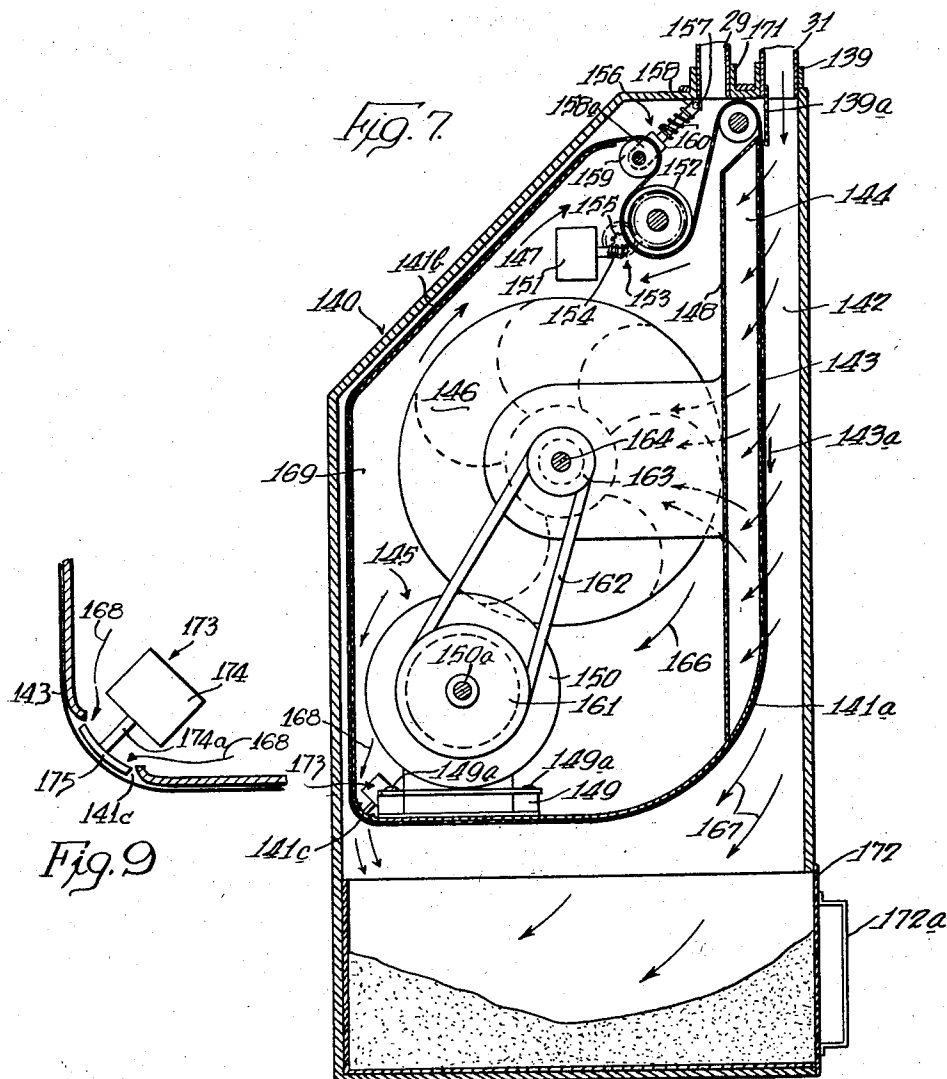
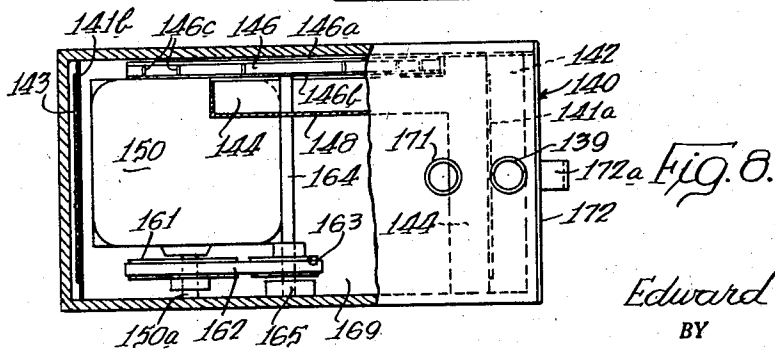
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DIFFERENTIAL PRESSURE CLEANING APPARATUS

Filed April 4, 1955

3 Sheets-Sheet 3



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2,875,846

DIFFERENTIAL PRESSURE CLEANING APPARATUS

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Application April 4, 1955, Serial No. 499,140

7 Claims. (Cl. 183—37)

The present invention relates generally to differential pressure cleaning apparatus and more particularly to a combined suction-pressure type cleaning device of the type employing a circulating air stream under pressure to dislodge dust particles from an area to be cleaned and also employing the suction created by the pressure source for returning the dust laden air stream for filtering.

While the apparatus of the present invention is capable of performing a wide variety of functions, it is particularly well suited for utilization in the graphic arts industry and, accordingly, the ensuing description is directed primarily to its use in this particular context. In the graphic arts industry, the sheet paper receiving the printed material frequently contains a number of impurities in the form of relatively loose particles such as protruding fibers and the like which, unless removed from the sheet, generally tend to collect upon and adhere to the printing type, thereby to cause smearing or distortion of the printed image. Moreover, and even more important, it is common practice in this industry to print upon one side of a sheet and then to sprinkle or dust powdered material such as cornstarch over the surface of the sheet prior to a second printing operation on the reverse side. The above described dusting operation avoids difficulties in the handling and storage of the sheet after the first printing operation which would otherwise be encountered as a result of the thickness of the printed material on only one side of the sheet, these difficulties being commonly referred to in the art as "offset" problems. However, it is imperative that the powdered material be removed from the sheet prior to the second printing operation in order to avoid the difficulties mentioned above with respect to the collection of loose material upon the printing type. Accordingly, one of the principal objects of the present invention is to provide an improved cleaning apparatus of the character described above wherein the aforementioned difficulties are obviated.

Another object of the present invention is to provide a new and improved differential pressure cleaning apparatus which is characterized by simple, inexpensive construction but is adapted to provide continuous fault-free operation over an extensive period of time.

A further object of the invention is to provide a new and improved closed differential pressure cleaning system for circulating air under pressure to a given area in order to dislodge and stir up dust particles in that area and for withdrawing the dust laden air for filtering and recirculation.

It is also an object of the present invention to provide a cleaning system of the type described above wherein the circulated air is constantly employed to clean the filtering device thereby to provide an extremely long lived continuously operating system wherein the necessity for frequent replacement of the components of the apparatus, such as the filter, is avoided.

It is likewise an object of the present invention to pro-

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vide a cleaning system of the character described including a continuously moving filter for separating the dust from the circulating air stream wherein the incoming air is directed across the filter surface in order to dislodge particles collected thereon, thereby to clean the filter and establish equilibrium operating conditions for the system.

The foregoing and other objects are realized, in accordance with the present invention, by providing a closed type cleaning system including a cleaning head for gathering dust laden air from an area to be cleaned. The cleaning head is placed in fluid communication with a combined pressure-suction source which receives the dust laden air, filters it, and returns substantially dust free air under pressure to the cleaning head in order to agitate and loosen the dust particles in the area to be cleaned. The filtering equipment comprises a moving type filter interposed in the path of travel of the dust laden air stream for the purpose of collecting dust and passing relatively clean air to the pressure-suction source for recirculation. In order to remove the particles collected upon the moving filter at least a portion of the incoming air is directed across the filter surface thereby cleaning the filter and depositing the dislodged particles in a suitable collecting chamber for removal. Thus, the circulating air establishes equilibrium operating conditions for the closed system and provides for continuous operation without replacement of the filter or other component elements of the apparatus.

The invention both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following detailed description taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a broken away plan view showing the cleaning head and the ducts leading thereto of the apparatus of the present invention assembled upon a typical printing press;

Fig. 2 is an enlarged partial sectional view taken along a line substantially corresponding to the line 2—2 in Fig. 1 and illustrating the cleaning head positioned to remove dust and other loose particles from a traveling sheet of paper;

Fig. 3 is an enlarged broken away bottom view of a portion of the cleaning head of the present invention as viewed when looking in the direction of the arrows 3—3 in Fig. 2;

Fig. 4 is an enlarged broken away sectional view of a portion of the cleaning head illustrated in Figs. 1 to 3, inclusive, and shows the effect of the cleaning head upon the traveling paper sheet;

Fig. 5 is a front elevation view partially in section of apparatus characterized by the features of the present invention with certain of the component elements being broken away in order to facilitate the illustration;

Fig. 6 is a side elevation view partially in section of the apparatus shown in Fig. 5 with a major portion of the side panel of the housing and a considerable portion of the filter drum being broken away;

Fig. 7 is a sectional view in elevation of an alternative arrangement of the apparatus of the present invention;

Fig. 8 is a plan view partially in section of the apparatus shown in Fig. 7 with the top of the housing removed to enhance the illustration; and

Fig. 9 is an enlarged fragmentary view of a portion of the apparatus shown in Fig. 7 particularly illustrating the vibrating mechanism for removing dust from the filter.

Referring now to the drawings and more particularly to Figs. 1 to 4 thereof, a cleaning head 10 is there illustrated for removing dust and other loose particles from an area to be cleaned and comprising an elongated

gated substantially rectangular housing divided into a pressure compartment 10a and a suction compartment 10b by a partition 10c extending longitudinally of the housing.

As previously indicated, the apparatus of the present invention is particularly well suited for operation in conjunction with machinery conventionally employed in the graphic arts industry. Thus, as illustrated in Fig. 2, the cleaning head 10 is adapted to remove dust and other loose particles from a traveling sheet of paper 15 carried upon a feed roller 16 of a printing press which may be of any conventional type. Since the printing press per se forms no part of the present invention only certain representative portions of a few of the elements thereof associated with the apparatus of the present invention have been shown in Figs. 1 and 2. Thus, the sheet feeding roller 16 is illustrated as a broken away portion of a cylinder rotatably supported upon suitable supporting structure indicated generally by the reference numeral 17. For the purpose of cooperating with the feed roller 16 to move the sheet of paper 15, there is provided a feed cylinder 19 having its periphery in engagement with the outer surface of the paper. The traveling paper sheet 15 is passed by the pair of feed rollers beneath a printing cylinder 20 which, of course, carries printing type (not shown in the drawings) upon its outer face in order to impress the desired image upon the sheet. The printing cylinder 20 is rotatably supported upon a mounting means 21 in spaced parallel position with respect to the feed cylinder 19 and in juxtaposition to the supply roll 16.

As previously mentioned, the paper sheet is conventionally sprinkled with powdered material such as cornstarch after the printing cylinder 20 has applied an image to one side of the paper and prior to printing on the reverse side. It is a primary purpose of the apparatus of the present invention including the cleaning head 10 to remove this powdered material and other loose particles appearing on the sheet 15 prior to engagement of the sheet by the printing cylinder 20 for the second printing operation on the reverse side of the sheet. As described above, dust or other particles present on the sheet, unless removed, tends to collect upon the type carried on the printed cylinder and causes the aforementioned difficulties with respect to distortion and smearing of the printing image.

Printing presses are generally designed for an optimum use of space, and, as a consequence, the spacing usually provided between the feed cylinder 19 and the printing cylinder 20 is somewhat limited. Accordingly, the cleaning head 10 and its associated elements must be designed to be accommodated within this limited space without interfering with the operation of the other moving parts of the press. To this end, the cleaning head 10 is illustrated in Fig. 2 as being assembled upon an elongated rod or bar 11 extending between fixed parallel frame members 12 of the printing press. For the purpose of supporting the bar 11, the opposed ends thereof carry mounting supports 13 which are bolted or otherwise secured to the frame members as indicated by the machine screws 14 shown in Figs. 1 and 2.

In order to provide for adjustment of the position of the cleaning head 10 upon the press, thereby to facilitate operation with different type presses or with presses employing feed rollers 16 having different diameters, the bar 11 carries a plurality of spaced adjustable supporting means 22. Each of these supporting means comprises a member 23 bifurcated at one end in order to straddle a lug 24 carried by the cleaning head 10 and provided at its other end with an internally threaded bore 23a for receiving an adjusting screw 26. The bifurcated end of the member 23 is attached to the lug 24 in any suitable manner as by the nut and bolt assembly 25. The adjusting screw 26 is retained within the bore 23a by means of a nut 26a in engagement with the end

portion of the member 23. The adjusting screw 26 of each of the supporting means 22 is also accommodated within an internally threaded bore 27a of a support 27 carried by the bar 11 and is retained therein by means of a nut 26b engaging the end portion of the support. Thus, it will be observed that limited adjustment of the position of the cleaning head 10 toward and away from the feed roller 16 for the purpose discussed above, may be effected by loosening nuts 26a and 26b and turning the adjusting screw 26. Since the bar 11 is oriented in fixed position upon the press, rotation of lead screw 26 induces movement of the cleaning head 10 toward or away from the bar, the direction of this movement, of course, being a function of the direction of rotation of the adjusting screw. When the cleaning head has been moved to the desired position with respect to feed roller 16, the nuts 26a and 26b are tightened in order to provide a rigid supporting assembly for maintaining the cleaning head in fixed position in proximity to the traveling sheet of paper 15. Thus, by proper adjustment of the screw 26, the cleaning apparatus of the present invention may be rendered effective for operation with printing presses of different design or with printing presses employing feed rollers 16 of different diameter.

For the purpose of supplying relatively clean air under pressure to the head 10 from a combined pressure-suction source of the type shown either in Figs. 5 and 6 or in Figs. 7 and 8 to be described in detail hereinafter, there is provided a duct or flexible tubing 29 which is connected at one end to the outlet of the source and at the other end to a manifold 30. A similar duct or tubing 31 is connected between the inlet to the source and a manifold 32 in order to withdraw dust laden air from the head 10. The manifolds 30 and 32 are supported in spaced parallel positions by a plurality of suitable brackets 33 carried upon the bar 11 and are respectively connected to the pressure compartment 10a and to the suction compartment 10b by a plurality of ducts or flexible tubes 34 and 35. The relatively clean air under pressure delivered from the source to the manifold 30 thus flows through ducts 34 to the pressure compartment 10a from which it is expelled through an elongated slot 10d formed in one slanted bottom portion 10e of the cleaning head 10 as best shown in Figs. 3 and 4.

Air flowing from the compartment 10a, as previously indicated, functions to agitate the dust or loose particles collected on the surface of the paper sheet 15 and creates a dust laden air volume which is drawn into the suction compartment 10b through an elongated slot 10f in a second slanted bottom portion 10g of the cleaning head 10. Since the cleaning head is located in proximity to the traveling paper sheet, the suction in compartment 10b draws the paper into the cavity formed by the slanted bottom portions 10e and 10g as shown in Fig. 4, thereby to create a small substantially enclosed space 36 containing dust laden air for withdrawal through the suction compartment 10b, through ducts 35 and into manifold 32. Movement of the paper sheet 15 into the space 36 straightens the traveling sheet and holds it in proper position for registry with the printing type carried upon the cylinder 20. The flow of relatively clean air from the compartment 10a and into the space 36 is indicated by the arrow pointed line 37 in Fig. 4, while the flow of dust laden air from space 36 into suction compartment 10b is indicated by arrow pointed line 38.

Turning now to Figs. 5 and 6 for a description of the combined pressure-suction source for delivering the dust free air to the pressure compartment 10a of the cleaning head 10 and for withdrawing the dust laden air from compartment 10b for filtering and recirculation, the equipment there illustrated comprises an enclosed rectangularly shaped housing 40 supported upon casters or wheels 41 to facilitate its movement to any desired

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location. The duct 31 connected to suction manifold 32 near the printing press functions to deliver dust laden air through the inlet 39 to an inlet chamber 42 formed between the walls of housing 40 and a drum 43 rotatably supported therein. The drum preferably comprises a perforated metal sheet covered by a relatively coarse porous fabric material and including an outer lamination of very fine porous filter preferably with a smooth outer surface which may be a textile or paper. The graded porosity of the filter permits maximum effectiveness of the fine filter since, if the latter were placed contiguous to the perforated metal sheet, it would be effective only in the areas over the perforations and would be sealed against the unperforated metal between the holes. The outer surface of the fine filter is preferably smooth in order to enhance the self cleaning of the filter as described in detail hereinafter. The coarse fabric permits all of the fine filter pores to operate by providing leakage paths to the holes in the metal, thereby forming passageways for air flowing from the inlet chamber 42 into a suction chamber 44 enclosed by the drum 43. A fan drive assembly, indicated generally by the reference numeral 45, is disposed within the suction chamber 44 for the purpose of rotating a fan 46. The drum 43 also encloses a drum rotating mechanism indicated generally as 47. The fan drive assembly 45 includes a rigid motor support bracket, comprising a plurality of spaced, parallel braces 48 rigidly supported at one end upon one wall of the housing 40 and having an end plate 49 bolted or otherwise secured to their other ends. A fan driving motor 50, preferably of the electrically operated type having a speed of 3600 revolutions per minute is mounted upon the motor support bracket as by the nut and bolt assemblies 48a shown in Fig. 6.

The drum rotating mechanism 47 preferably includes a small electric motor 51 supported upon the end plate 49 in any suitable manner as by spaced bolts 52 interconnecting the end plate 49 and a bracket 53 on the motor. The motor 51 is adapted to drive its shaft 54 at any suitable but relatively low speed. A small spur gear 55 carried by motor shaft 54 cooperates with a large gear 56 to form a speed reduction drive for shaft 57 having one end rotatably journaled within a bearing assembly 58 mounted upon the end plate 49 and having a drum support plate 59 secured to its other end. In order to impart the rotation of the shaft 57 to drum 43, the latter is attached as by machine screws 60 to the drum supporting plate 59.

The speed of rotation of the drum 43 is a function of the speed of rotation of motor 51 and also of the speed reduction effected by the gears 55 and 56 and, in one particular application of the apparatus of the present invention a rate of rotation of the drum of about one-sixth revolution per minute was found to produce satisfactory results.

In order to provide access to the interior of the housing 40 for repair or service of the apparatus embodied therein, one of its side panels 40a is preferably removable. To facilitate removal of this panel, there is provided a handle 62 which may be raised until the lower end of the panel 40a is lifted above the level of lip 40b at which time the panel may be withdrawn. With the panel 40a removed the drum 43 may be disassembled from its drive mechanism 47 by loosening a set screw 81a holding a drum retainer ring 81 upon the shaft 57. After set screw 81a is loosened the ring 81 may be removed and the drum 43 may be lifted from the housing to permit access to the component elements of the fan drive assembly 45 and of the drum rotating assembly 47. After the necessary repairs and service have been completed, the equipment may, of course, be re-assembled by inserting the removed parts in the proper positions.

In order to supply electrical energy for actuating both of the motors 50 and 51, an electrical connection box

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61 is supported externally of the housing 40 upon one of its end walls. The inlet to the connection box 61 comprises a suitable electrical conductor 63 having one end terminating in a conventional plug 64 adapted to be connected to a suitable source of power not shown in the drawings. With the plug 64 connected to the source of power and with a start-stop switch 65 in the connection box 61 in the "on" position, indicating light 66 is illuminated and energizing current is simultaneously applied to the motors 50 and 51 with the result that the drum 43 is continuously rotated at relatively low speed preferably in the direction of the arrow 43a in Fig. 5, while, at the same time, the fan 46 is rotated at high speed. In order to prevent the entry of dust laden air directly from the inlet chamber 42 into the suction chamber 44 without passing through the filter on the drum 43, the drum carries an annular resilient disc 67 having a curved end portion 67a in continuous engagement with an annular ring 68 mounted internally of the housing 40 on one of its walls. The ring 68 is preferably formed of a layer of sponge rubber and a relatively thin felt lamination and, accordingly, provides an air sealed cushion for the end portion 67a.

The fan 46 may be of any suitable construction but preferably comprises a pair of parallel discs 46a and 46b supporting a plurality of spaced radial vanes 46c and carried upon shaft 50a driven by the motor 50. The disc 46a is attached to the shaft 50a by means of a mounting assembly including a plate 50b bolted or otherwise secured to that disc. When the fan 46 is rotated at high speed by the motor 50, a suction is created within the chamber 44 enclosed by drum 43 in order to draw dust laden air through the filter carried by the drum. The dust is collected by the filter so that the air passing into the suction chamber 44 is relatively clean. This clean air is passed through the fan 46 in order to create a pressure within a pressure chamber 69 formed by a panel member 40c of the housing 40. In order to minimize the direct flow of air between the pressure chamber 69 and the suction chamber 44 around the face of the fan 46 there is provided an annular ring 70, similar in construction to the ring 68, located in proximity to the fan 46 and carried upon a wall 40d of the housing 40. The air within the pressure chamber 69 is delivered from an outlet 71 through the duct 29 to the cleaning head 10.

In order to provide for constant removal of the dust collected by the filter, thereby to effect continuous operation of the equipment, the dust laden air flowing through inlet 39 is directed by a suitable baffle 39a across the surface of the filter on the drum 43. It will be observed that the outer periphery of the drum 43 is relatively close to the walls of the housing 40 at certain points in the inlet chamber designated by the reference numerals 42a and 42b. At these particular points the dust laden air in the inlet chamber 42 is accelerated with the result that air flows across the filter with sufficient force to dislodge the dust and other particles accumulated thereon. The baffle 39a reduces turbulence in the inlet chamber 42 and, in effect, assures travel of the air across the surface of the drum in a single direction as indicated by the arrow pointed lines 42c in Fig. 5. The dust removed from the filter falls through the inlet chamber to the bottom of the housing where it is deposited within a suitable drawer 72 having a handle 72a thereon to permit removal of the dust while the apparatus is in operation. A plurality of vertical baffles 72b in the drawer 72 reduce turbulence of the air flowing within the inlet chamber 42 and induce an approximately uniform distribution of dust particles within the various drawer compartments formed by these baffles.

The use of the circulated air to clean the filter is a very important feature of the present invention in that it provides for uninterrupted operation of the apparatus under approximately uniform operating conditions. Since

dust is prevented from clogging up the perforations in the surface of the drum by the continuous flow of air across the filter, equilibrium flow conditions are established and the efficiency of the filtering does not fall off under continued use of the equipment. Moreover, the apparatus is well adapted for the continuous operation which is necessary for use in conjunction with printing presses since the dust removed from the filter accumulated within drawer 72 may be removed without shutting down either the press or the cleaning apparatus. Furthermore, since the filter is continuously cleaned by air from the inlet 39, it will possess an extremely long useful life without requiring replacement.

From the foregoing explanation, it will be apparent that when the apparatus shown in Figs. 1 to 6, inclusive, is placed in operation by actuating the starting switch 65, the motors 50 and 51 are energized in order to rotate the drum 43 and to drive the fan 46. Rotation of the fan creates pressure within the pressure chamber 69 to induce a flow of relatively clean air from the outlet 71, through duct 29, into manifold 30, through ducts 34, into pressure compartment 10a in the cleaning head 10 and through the slot 10d. The air emerging from slot 10d impinges upon the traveling paper sheet, removes the dust and other loose particles collected thereon and produces a dust laden air stream with the space 36. The suction created by rotation of fan 46 withdraws the dust laden air from space 36 through slot 10f, into suction compartment 10b, through ducts 35, into suction manifold 32, through duct 31, through the inlet 39, and into the inlet chamber 42 within the housing. The dust in the air supply within chamber 42 is removed by the filter carried upon drum 43 as the air is drawn into the suction chamber 44 for recirculation by the fan 46. Dust particles collected on the surface of the filter are dislodged by acceleration of the air flowing through the inlet 39 at the points 42a and 42b of the inlet chamber, thereby to deposit the dust particles in the drawer 72 at the bottom of the housing 40 for removal. Thus, it will be observed that the apparatus described comprises a closed system wherein the circulated air not only stirs up and removes dust from an area to be cleaned but also functions continuously to clean the filtering equipment for removing dust from the circulated air stream.

Turning now to Figs. 7 and 8 for a description of an alternative arrangement of the combined pressure-suction source adapted to operate in conjunction with the cleaning equipment shown in Figs. 1 to 4, inclusive, apparatus is there illustrated comprising a housing 140 having an inlet 139 connected through duct 31 to the manifold 32. Structure, including a pair of plates 141a and 141b, is provided within the housing in order to form an inlet chamber 142 for receiving dust laden air from the inlet 139. The plate 141a is perforated to permit the passage of air from the inlet chamber 142 as indicated by the arrow pointed lines passing through this plate. A chamber forming housing 148 cooperates with the plate 141a to define a suction chamber 144 and also cooperates with the plates 141a and 141b to define a pressure chamber 169. An endless belt 143 of suitable filter material such as porous filter paper surrounds the plates 141a and 141b and is continuously moved thereover in the direction indicated by arrow pointed line 143a by means of a filter drive assembly indicated generally by the reference character 147. This drive assembly comprises a small electric motor 151 mounted upon one of the walls of the housing 140 and adapted to drive a friction type belt driving roller 152 through a speed reduction mechanism 153 including worm gear 154 and driven gear 155. An idler assembly 156 mounted for pivotal movement about a pin 157 secured near the top of the housing 140 functions to maintain proper tension on the endless belt 153. The latter idler assembly comprises an arm 158 which supports a bracket 158a carrying an idler roller 159 in engagement

with the belt and a spring 160 which normally urges the bracket 158a and roller 159 toward the pivot pin 157 in order to tension the belt.

In order to create pressure within the pressure chamber 169 and, at the same time, to produce suction within the chamber 144, there is provided a fan 146 driven at relatively high speed in the direction indicated by arrow pointed line 166 in Fig. 7 by a fan drive assembly indicated generally as 145. The fan drive assembly comprises an electric motor 150 mounted upon a motor support 149 which is attached to the plate 141a in any suitable manner as by the machine screws 149a shown in Fig. 7. The motor 150 rotates its armature shaft 150a and a pulley 161 mounted thereon in order to drive a belt 162 and impart the rotation of the armature shaft to a fan drive shaft 164 through a pulley 163. The fan drive shaft 164 is journaled within a suitable bearing assembly as indicated at 165 and extends from this bearing assembly through pressure chamber 169, through opposed parallel walls of the chamber forming housing 148, and through the suction chamber 144 to receive the fan 146. The latter fan comprises a pair of parallel discs 146a and 146b interconnected by a plurality of spaced, curved vanes 146c and functions to create pressure within the chamber 169 for delivering relatively clean air from outlet 171 of the housing through duct 29 to the cleaning head 10.

The chamber 144 is open to the suction side of the fan 146 so that the pressure within this chamber is less than that of the inlet chamber 142. The suction within the chamber 144 created by rotation of the fan 146 draws air from the inlet chamber 142 through the endless filter 143 and through the perforations in plate 141a in order to separate the dust particles from the air. The separated particles, of course, tend to accumulate upon the filter 143 but are removed to some extent by a stream of dust laden air directed from the inlet 139 across the surface of the filter by means of a baffle 139a. The latter baffle is preferably located in proximity to the moving filter belt 143 and, hence, prohibits the passage of dust laden air directly to the outlet 171 without passing through the filter. Particles dislodged from the filter 143 by the air stream are passed directly to the bottom of the housing 140 as indicated by the arrow pointed lines 167 in Fig. 7 where they are collected within a drawer 172. In order to provide for withdrawal of the drawer and removal of the dust collected therein without terminating the operation of the cleaning apparatus, the drawer is provided with a handle 172a.

For the purpose of agitating the filter 143 in order to provide additional dust removing facilities, a vibrating mechanism 173 is mounted upon one wall of the housing 140 as best shown in Figs. 7 and 9. This mechanism comprises a conventional vibrating motor 174 for reciprocating shaft 174a in order to vibrate a cleaning element 175 in engagement with the outer surface of the filter 143.

To provide means for removing the dust loosened by the vibrating mechanism 173 in order to clean the filter 143, a small stream of relatively clean air under pressure is directed from the pressure chamber 169 through a small opening 141c between plates 141a and 141b. It will be recalled from the foregoing description that the chamber 169 is open to the pressure side of the fan 146 so that the air therein is at higher pressure than that in the inlet chamber 142. The air ejected through the opening flows in the direction of the arrow pointed lines 168 in Figs. 7 and 9 and passes through the filter 143 in a direction opposite to the flow of air into the suction chamber 144. As a consequence, the dust particles are removed from the filter and are deposited within the drawer 172.

From the foregoing explanation it will be apparent that the operation of the apparatus shown in Figs. 7 and 8 is initiated by energizing motors 150 and 151 in order to

rotate the fan 146 at relatively high speed and to move the filter 143 over the plates 141a and 141b at relatively low speed. Rotation of fan 146 produces air under pressure within the chamber 169 for passage from outlet 171, through duct 29, to manifold 30, through ducts 34, to compartment 10a and through the slot 10d to impinge upon the traveling sheet 15 of paper. Dust laden air created by the air under pressure is returned to the inlet 139 through duct 31 in the manner previously described and flows into the inlet chamber 142. A small portion of the dust in the air falls directly into the drawer 172 by the action of gravity. The dust eliminated from the filter 143 by the flow of incoming air thereacross is also deposited within the drawer. The air in the inlet chamber 142 flows through the filter 143 in order to remove the dust, thereby to pass relatively clean air to the suction chamber 144 for recirculation by the fan 146. The filter 143 is continuously agitated by vibrating mechanism 173 and is also continuously subjected to the clean air stream passing through opening 141c in order to provide for the effective elimination of practically all of the dust particles collected on the filter. Thus, the apparatus shown in Figs. 7 and 8, like that shown in Figs. 5 and 6 previously described, cooperates with the cleaning head 10 and its associated elements to provide a continuously operated closed cleaning system wherein circulated air is employed to remove dust from an area to be cleaned and is also employed to clean the filtering equipment.

While the particular embodiments of the invention have been shown, it will be understood, of course, that the invention is not limited thereto since many modifications may be made and it is therefore contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A combined pressure-suction type cleaning device comprising a housing of box-like construction having two side walls, first and second end walls and top and bottom walls, an inlet in said first end wall for delivering dust-laden air to the interior of the housing, a motor support secured to one of the side walls and extending into the housing, a motor mounted upon said support and having a shaft portion extending through an opening in said one side wall, a second motor mounted on said support, a rotary filter drum encircling both of said motors and said support and dividing the interior of said housing into a pair of chambers, one of said chambers being an inlet chamber communicating with the inlet and located between the outer surface of the drum and the walls of the housing and the other of said chambers being a suction chamber located within the drum, means on said support journalling said drum for rotation within said housing, gear means connecting said second motor to drive said drum, fan blades mounted on said shaft portion of said first motor adjacent said opening, a closure secured to said housing and enclosing said fan to define a pressure chamber communicating with the suction chamber through said fan blades and said opening, whereby rotation of said fan blades by said first motor creates suction within the suction chamber in order to draw dust-laden air from the inlet chamber through the filter drum and also creates pressure within the pressure chamber, an outlet from the pressure chamber for delivering pressurized air, baffle means for directing the air from the inlet to pass tangentially over said drum between the drum periphery and the top wall, said journalling means being effective to support said drum in a position wherein it is spaced from but close to the top wall and said second end wall in order to define regions where the air from the inlet speeds up as it passes tangentially over the drum surface in order to remove dust collected on the drum and force the removed dust to the bottom of the housing, and baffle means adjacent said inlet for directing the

inlet air through the region between the top wall and the drum.

2. The apparatus defined by claim 1 wherein removable collecting means are provided adjacent the bottom of said housing for collecting dust particles removed from the filter drum.

3. A combined pressure-suction type cleaning device comprising a housing of box-like construction having two side walls, first and second end walls and top and bottom walls, an inlet in the first end wall for delivering dust-laden air to the interior of the housing, a motor support secured to one of the side walls within said housing, a motor mounted upon said support and having a shaft portion extending through an opening in said one side wall, a second motor mounted on said support, a rotary filter drum encircling both of said motors and said support and dividing the interior of said housing into a pair of chambers, one of said chambers being an inlet chamber communicating with the inlet and located between the outer surface of the drum and the walls of the housing and the other of said chambers being a suction chamber located within the drum, means on said support journalling said drum for rotation within said housing, means connecting said second motor to drive said drum, fan blades mounted on said shaft portion of said first motor adjacent said opening, a closure secured to said housing and enclosing said fan to define a pressure chamber communicating with the suction chamber through said fan blades and said opening, whereby rotation of said fan blades by said first motor creates suction within the suction chamber in order to draw dust-laden air from the inlet chamber through the filter drum and also creates pressure within the pressure chamber, an outlet from the pressure chamber for delivering pressurized air, means for causing the air from the drum to pass over the drum surface between the drum periphery and the top wall, said journalling means being effective to support said drum in a position wherein it is spaced from but close to the top wall of the housing in order to provide a region where the air from the inlet speeds up as it passes over the drum surface in order to remove dust collected thereon and force it to the bottom of the housing.

4. A combined pressure-suction type cleaning device comprising a housing of box-like construction having two side walls, two end walls and top and bottom walls, an inlet for delivering dust-laden air to the interior of the housing, a motor support secured to one of the walls and extending into said housing, a motor mounted upon said support and having a shaft portion extending through an opening in said one wall, a second motor mounted on said support, a rotary filter drum encircling both of said motors and said support and dividing the interior of said housing into a pair of chambers, one of said chambers being an inlet chamber communicating with the inlet and located between the outer surface of the drum and the walls of the housing and the other of said chambers being a suction chamber located within the drum, means on said support journalling said drum for rotation within said housing, means connecting said second motor to drive said drum, fan blades mounted on said shaft portion of said first motor adjacent said opening, a closure secured to said housing and enclosing said fan to define a pressure chamber communicating with the suction chamber through said fan blades and said opening, whereby rotation of said fan blades by said first motor creates suction within the suction chamber in order to draw dust-laden air from the inlet chamber through the filter drum and also creates pressure within the pressure chamber, an outlet from the pressure chamber for delivering pressurized air, said journalling means being effective to support said drum in a position wherein it is spaced from but close to at least one of the walls of the housing in order to provide a region where the air from the inlet speeds up as it passes tangentially over the drum surface in order to remove dust

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collected thereon and force it to the bottom of the housing, and means for causing air from the inlet to pass tangentially over the drum surface between the drum and said one wall of the housing.

5. The apparatus defined by claim 4 wherein there is provided baffle means carried by the housing adjacent said inlet for directing dust-laden air into said region and tangentially across the drum periphery.

6. A combined pressure-suction type cleaning device comprising a housing of box-like construction having side walls and top and bottom walls, an inlet for delivering dust-laden air to the interior of the housing, support structure secured to one of the side walls and extending into said housing, a rotary filter drum supported by said support structure and dividing the interior of said housing into a pair of chambers, one of said chambers being an inlet chamber communicating with the inlet and located between the outer surface of the drum and the walls of the housing and the other of said chambers being a suction chamber located within the drum, means on said support journalling said drum for rotation within said housing, means for rotating said drum, a fan blade supported by said support structure and communicating with said suction chamber, means defining a pressure chamber communicating with the suction chamber through said fan, whereby rotation of said fan creates suction within the suction chamber in order to draw dust-laden air from the inlet chamber through the filter drum and also creates pressure within the pressure chamber, an outlet from the pressure chamber for delivering pressurized air, said journalling means being effective to support said drum in a position wherein it is spaced from but close to the top wall and at least one of the side walls of the housing in order to provide regions where the air from the inlet speeds up as it passes tangentially over the drum surface in order to remove dust collected thereon and force it to the bottom of the housing, and baffle means adjacent said inlet for directing the inlet air to pass tangentially over the drum surface through the region between the top wall and the drum.

7. A combined pressure-suction type cleaning device comprising a housing of box-like construction having side walls and top and bottom walls, an inlet for delivering dust-laden air to the interior of the housing, support structure secured to one of the walls and extending into

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said housing, a rotary filter drum supported by said support structure and dividing the interior of said housing into a pair of chambers, one of said chambers being an inlet chamber communicating with the inlet and located between the outer surface of the drum and the walls of the housing and the other of said chambers being a suction chamber located within the drum, means on said support journalling said drum for rotation within said housing, means for rotating said drum, a fan supported by said support structure and communicating with the suction chamber, means defining a pressure chamber around said fan so that rotation of said fan creates suction within the suction chamber in order to draw dust-laden air from the inlet chamber through the filter drum and also creates pressure within the pressure chamber, an outlet from the pressure chamber for delivering pressurized air, said journalling means being effective to support said drum in a position wherein it is spaced from but close to at least one of the walls of the housing in order to provide a region where the air from the inlet speeds up as it passes tangentially over the drum surface in order to remove dust collected thereon and force it to the bottom of the housing, and means for causing air from the inlet to pass tangentially over the drum surface and through the space between the drum and said one wall of the housing.

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